CLAIMS

What is claimed is:

1. An implantable medical device for implant within a patient, a method for detecting ventricular electrical events comprising:

sensing bipolar signals using a bipolar lead mounted within the atria and detecting atrial events therein;

sensing unipolar signals using a lead mounted within the heart, the unipolar signals having potentially both atrial and ventricular events therein;

eliminating the atrial events from the unipolar signals to leave substantially only ventricular events therein; and

examining the ventricular events remaining within the unipolar signals to identify repolarization events.

2. The method of claim 1 further including the steps of:

identifying peaks of the ventricular repolarization events; and

specifying repolarization windows based on the repolarization event peaks.

3. The method of claim 2 wherein specifying repolarization windows based on the repolarization event peaks comprises:

identifying a starting point of the repolarization window as commencing 150 milliseconds (ms) prior to a repolarization event peak; and

identifying a ending point of the repolarization window as terminating 150 ms after the repolarization event peak.

4. The method of claim 1 wherein examining the ventricular events to identify repolarization events comprises:

detecting ventricular depolarization events within the remaining unipolar signals;

identifying peaks of the ventricular depolarization events; and

specifying repolarization windows based on the depolarization event peaks.

5. The method of claim 4 wherein specifying repolarization windows based on the depolarization event peaks comprises:

identifying a starting point of the repolarization window as commencing 80 milliseconds (ms) after the depolarization event peak; and

identifying a ending point of the repolarization event window as terminating 480 ms after the depolarization event peak.

6. The method of claim 1 further comprising:

determining energy values associated with the ventricular repolarization events; and

detecting cardiac ischemia based on the energy values of the ventricular repolarization events.

7. The method of claim 1 further comprising determining maximum slopes of the ventricular repolarization events and wherein detecting cardiac ischemia based on energy values comprises utilizing the maximum slopes of the ventricular repolarization events.

8. The method of claim 6 wherein detecting cardiac ischemia is performed to detect acute cardiac ischemia so as to predict a subsequent acute myocardial infarction (AMI).

9. The method of claim 6 wherein determining an energy value associated with ventricular repolarization events comprises calculating:

$$E_{T\text{-}Wave} = \sum_{n=Tstart}^{Tend} s(n)$$

wherein s(n) is a digitized version of the cardiac signal, T_{start} and T_{end} are start and end points, respectively, of the repolarization event, and n represents individual samples of the digitized version of the cardiac signal.

10. The method of claim 6 further comprising:

detecting a ventricular depolarization event within the cardiac signals that corresponds to the repolarization event;

determining whether the ventricular repolarization event was the result of a paced beat or a sinus beat; and

wherein the step of detecting cardiac ischemia based on the energy values of the repolarization events takes into account whether the ventricular repolarization events are the result of a paced beat or a sinus beat.

11. The method of claim 10 wherein, in response to a sinus beat, detecting cardiac ischemia comprises:

determining a peak amplitude of the depolarization event that corresponds to the repolarization event;

normalizing the energy values of the repolarization events based on the peak amplitude of the corresponding depolarization event;

determining a running average of normalized energy values of repolarization events;

calculating a difference between a current repolarization event energy value and the sinus event running average; and

determining whether the difference exceeds a predetermined sinus beat detection threshold.

12. The method of claim 11 wherein, if sensed, the step of detecting cardiac ischemia includes the initial step of:

determining whether the sensed beat is an ectopic beat and, if so, ignoring the repolarization event associated with the ectopic beat in the detection of cardiac ischemia.

13. The method of claim 10 wherein, in response to a paced event, detecting cardiac ischemia comprises:

determining a measure of evoked response for the depolarization event that corresponds to the repolarization event;

normalizing the energy values of the repolarization events based on the evoked response of the corresponding depolarization event;

determining a running average of normalized energy values of paced repolarization events;

calculating a difference between a current paced repolarization event energy value and the paced event running average; and

determining whether the difference exceeds a predetermined paced beat-based detection threshold.

14. The method of claim 13 wherein, in response to a paced event, detecting cardiac ischemia comprises:

determining whether the paced beat is a fused beat and, if so, ignoring the repolarization event associated with the fused beat in the detection of cardiac ischemia.

15. The method of claim 1 further comprising:

generating a warning signal indicative of the onset of ischemia.

16. The method of claim 15 wherein the warning signal is an internal warning signal applied directly to patient tissue and has a stimulation frequency different from any other warning signal generated by the device.

17. The method of claim 1 wherein sensing unipolar signals using a lead mounted within the heart is performed using a unipolar lead mounted in a ventricle.

18. The method of claim 1 wherein sensing unipolar signals using a lead mounted within the heart is performed using a bipolar lead mounted in a ventricle operating in a unipolar mode.

19. The method of claim 1 wherein sensing unipolar signals using a lead mounted within the heart is performed using a bipolar lead mounted in an atrium operating in a unipolar mode.

20. An implantable medical device for implant within a patient, a system for detecting ventricular electrical events comprising:

a bipolar signal processing unit operative to sense bipolar signals using a bipolar lead mounted within the atria and to detect atrial events therein;

a unipolar signal processing unit operative to sense unipolar signals using a lead mounted within the heart, the unipolar signals having potentially both atrial and ventricular events therein;

an atrial event rejection unit operative to eliminate the atrial events from the unipolar signals to leave substantially only ventricular events therein;

a T-wave detection unit operative to examine the ventricular events remaining within the unipolar signals to identify ventricular repolarization events (T-waves) therein.

21. The system of claim 20 further including:

a T-wave energy integration subsystem operative to detect a total energy associated with individual T-waves; and

a cardiac ischemia detection subsystem operative to detect cardiac ischemia based on the total energy of the individual T-waves.

22. An implantable medical device for implant within a patient, a system for detecting ventricular electrical events comprising:

means for sensing bipolar signals using a bipolar lead mounted within the atria and detecting atrial events therein;

means for sensing unipolar signals using a lead mounted within the heart, the unipolar signals having potentially both atrial and ventricular events therein;

means for eliminating the atrial events from the unipolar signals to leave substantially only ventricular events therein;

means for examining the ventricular events remaining within the unipolar signals to identify ventricular repolarization events; and

means for detecting cardiac ischemia based on total energy values of the ventricular repolarization events.